Child Poverty in China-A Multidimensional Deprivation Approach

Abstract

This paper applies a human-rights based deprivation approach to measure child poverty in China based on secondary data analysis. It discusses the following questions: How to select available deprivation indicators to measure child poverty in China? Are the available deprivation indicators valid, reliable and additive? How did child poverty change between1989 and 2009 and how did it vary by region? The main objective is to use existing longitudinal and cross sectional survey data to build scientific deprivation indicators to measure the living standards of children and produce estimates of child poverty in China across time and space. All waves from 1989 to 2009 of the China Health and Nutrition Survey (CHNS) data will be utilized. In order to choose a set of deprivation indicators, several statistical tests for the validity, reliability and additivity of the deprivation items are developed. Validity tests aim to check whether income has a significant association with deprivation indicators using binary logistic regression; A Classical Test Theory (CTT) model is used to determine if the list of deprivation items form a reliable scale/index.; The final test shows whether the deprivation indicators are additive or not. This methodology builds on the work of Gordon (2000, 2006) and final list of valid, reliable and additive deprivation indicators is applied to explore child poverty across time and space. The findings indicate that children's living standards in China have improved over time but that significant regional disparities remain.
.

Keywords
Child poverty, Material deprivation, Validity, Reliability, Additivity

I Introduction

1.1 Conceptualizing and Measuring Child Poverty

In this paper, a human-rights based multidimensional deprivation approach is used to measure child poverty in China. The basic human rights of children have been outlined in the Convention on the Rights of Child (UNCRC, 1989) which can be used to provide a universal framework for the definition and measurement of child poverty. The rights in UNCRC are grouped into three dimensions in UNICEF's Flagship *State of the World's Children* (UNICEF, 2009) report, which are survival and development, protection and participation rights. Children have rights to adequate nutritious food, clean drinking water, sanitation facilities, healthcare, education, leisure activities, information, to be protected from economic exploitation and to grow up in a family, etc. Many of these rights are also considered as dimensions of child poverty and violations of them are treated as deprivations (Gordon et al., 2003). Under this framework, child poverty is defined by the United Nations as being '*deprived of nutrition, water and sanitation facilities, access to basic health-care services, shelter, education, participation and protection, that a severe lack of these goods or services is threatening and harmful to children, leaving them unable to enjoy their rights, reach their potential and participate as full members of society*' (United Nations General Assembly, 2006, p.46). The UN definition is also similar to the minimum core obligation for the fulfilment of basic human rights identified by the UN Committee on Economic, Social and Cultural Rights, '*a minimum core obligation to ensure the satisfaction of, at least, minimum essential levels of each of the rights is incumbent upon every member state party. Thus, for example, a state party in which any significant number of individuals is deprived of essential foodstuffs, of essential primary health care, of basic shelter and housing, or of the most basic form of education is, prima facie, failing to discharge its obligations under the convention*' (ICESCR, 1990).

Under the human-rights framework, Gordon et al (2003) developed a multidimensional deprivation approach to measure absolute child poverty in developing countries. Seven dimensions were developed covering food, water, sanitation facilities, shelter, health, education and information. Deprivation indicators used in this approach are based on poverty definitions agreed at the 1995 Copenhagen World Summit. Gordon et al (2003) also developed evidence-based deprivation thresholds for different age groups of children. If children are deprived of access to two dimensions, they are considered as living in absolute poverty. This is also known as Bristol Deprivation Approach or Global Study Methodology (UNICEF, 2011). This methodology has been used by UNICEF in its Global Study on Child Poverty and Disparities[1] in more than 50 countries. Similarly, the Young Lives Project[2] also utilizes a deprivation approach to examine child poverty by developing multidimensional deprivation indicators, such as children's access to basic services (electricity, water and toilet facilities), child malnutrition, access to primary healthcare services, child labour, etc. It measures child poverty over a long time period for 15 years in four countries (Ethiopia, Peru, Vietnam and India) and has similar findings as the Bristol study (Gordon et al., 2003) that poor children are deprived of basic needs and their basic human rights are violated. The deprivation approach captures the multidimensional nature of child poverty and reflects children's basic human

[1] Available at: http://www.unicef.org/socialpolicy/index_45357.html
[2] Available at: http://www.younglives.org.uk/

rights ratified in CRC (Pemberton et al., 2007).

1.2 Background of child poverty issues in China

After the 1978 economic reform, China experienced rapid economic growth and improvements to general living standards. According to data from the World Bank[3], China's average annual GDP growth rate was 9.9% from 1979 until 2011. China had a low per capita GDP of only US$175 in 1978, and this figure increased to over US $5,445 by 2011. The number of people living in absolute poverty fell dramatically during this period as measured by both the income poverty line of Chinese government and the international absolute poverty line ('dollar a day' World Bank line) (World Bank, 2009). There is no official figure on the numbers of children living in poverty, but UNICEF (2005) estimated, that China has less child deprivation than many other developing countries according to Gordon et al' s (2003) deprivation method. On a range of indicators related to children's survival and development, China has performed relatively well. For example, the infant mortality rate fell from 50.2 per thousand live births in 1991 to 14.9 in 2008 and the under-five mortality rate fell from over 6.1% in 1991 to less than 1.8% in 2007 (UNICEF, 2010). China has also effectively achieved universal primary education (UN China, 2010). The primary school enrolment rate was 99.4% and junior secondary enrolment rate was 99% by the end of 2009. Similarly, the proportion of children attaining nine-year compulsory education was 99.3%. China has clearly made great progress in reducing child poverty and deprivation during the last three decades.

However, this progress is uneven and regional disparities are significant. Rural children and children in poor regions of China are still suffering from absolute poverty and deep deprivation. According to the UNICEF report on *children's welfare in China* (UNICEF, 2011), rural children are severely deprived of access to basic infrastructure, e.g. safe drinking water, sanitation facilities, good health care and education. In rural China, it is estimated that over 75% children from low-income families rely on unsafe drinking water which may lead to serious sickness problem. Lu and Wei (2002) estimated that children living in interior rural areas are 2.5 times more likely to be poor compared with coastal rural regions. Malnutrition remains a significant problem for many poor children in China (UNICEF, 2011). Regional disparities in access to information are also significant. UNICEF (2005) reported that nearly 20% of internet users are children and over half of these children live in the six most developed Eastern provinces. By comparison, the poorest six areas account for less than 1% of child internet users. The basic survival and developmental rights of many children in poor regions of China are still not being satisfied. Significantly, child deprivation is much more severe in poor regions and rural areas than the developed urban cities. Based on this general background, it's important to focus on children's material living conditions in order to compare child poverty between different regions and explore the trends over time.

1.3 Dimensions and Indicators of Child Deprivation

An important issue for the multidimensional deprivation approach is the selection of deprivation dimensions and indicators. Atkinson et al (2002, p.21) argue that '*an indicator should identify the essence of the problem and*

[3] http://www.worldbank.org/en/country/china/overview

have a clear and accepted normative interpretation'. So, indicators included should be informative of child-related problems or issues, which mean that the lack of the items is likely to adversely affect the child's health or development (Gordon et al, 2003). Another underlying normative principle is that the potential deprivation items should be customary and commonly accepted as 'necessities' in the given society. The selection of indicator, which follow value judgement and assumptions, should be made clear and explicit (Roelen et al., 2009). Alkire (2008) identifies five selection methods, which reply on existing data (data assessment), normative assumptions (theories or previous research), public consensus (e.g. UNCRC, MDGs and constitutional rights), expert opinion and participatory processes (asking the public).

Townsend (1979) pioneered the relative deprivation approach to measure poverty and developed a list of sixty deprivation indicators to reflect various dimensions of people's living conditions in Britain which were considered to be customary and socially accepted at that time. These indicators cover material and social aspects of people's living standards. This was in part an expert opinion approach to select indicators. To avoid arbitrary judgement by experts in selecting necessary items, Mack and Lansley (1985) used a participatory process to develop deprivation indicators by asking the public what items they consider to be necessities of life, this is known as the consensual or socially perceived necessities approach. A large-scale survey covering the public-recognized necessities is used to identify who lacks these items and why they lack them (i.e. due to choice or constraint). A person who is financially constrained and can't afford a necessity is considered to be deprived of that item. The consensual methodology is widely used to measure poverty in many countries because it '*combines a representative popular basis for agreeing what are necessities, with a scientific basis for establishing a level of poverty'* (Gordon et al., 2000). In an attempt to select appropriate indicators to measure multidimensional child poverty in Europe, Notten and Roelen (2010) follow a different method, combing the normative assumptions and public consensus approach, in developing appropriate indicators. Firstly, they start from a conceptual framework of child poverty, that each indicator should be informative of child-related issues and the reduction of one poverty indicator is considered as an improvement. Another principle is that indicators are relevant across EU countries in order to achieve universal comparison. They assess the indicators based on whether it can be interpreted under UNCRC or whether it has been used by previous research. They finally include 13 child deprivation indicators under four domains, which are housing conditions, neighbourhood conditions, access to basic services and financial means.

In terms of China's child poverty research, some scholars have developed child-focused indicators to measure multidimensional poverty. For example, Lau and Bradshaw (2010) provide a comprehensive framework which includes six domains and 46 indicators to compare child wellbeing among thirteen countries in the Pacific Rim including China. This research develops child wellbeing domains and indicators based on sample surveys and administrative data. The indicators cover children's material, social and subjective wellbeing. Wang and Shang (2011) select three deprivation indicators to measure children's access to basic services by analyzing the 2010 baseline survey in five provinces[4], which includes children's access to safe drinking water, sanitation facilities and unprocessed solid cooking fuel. They develop these three indicators based on the UNCRC and MDGs, and also on development strategies of the Chinese government and policy guidelines on *children's future*

[4] Children's wellbeing baseline survey in Shanxi, Henan, Yunan, Sichuan and Xinjianig, conducted in 2010.

development from 2011 to 2020 (State Council, 2011). Based on the multidimensional poverty index (MPI) methodology (Alkire and Foster, 2008), Zou and Fang (2011) use three dimensions and eight deprivation indicators to measure poverty over time and between different regions in China with a secondary analysis of China Health and Nutrition survey data (CHNS) from 1989 to 2009. They choose poverty indicators and deprivation threshold mainly based on MDGs. Poverty indicators used in this study include income, education, safe drinking water, sanitation facilities, unprocessed solid cooking fuel, electricity, housing and consumer durables. Similarly, Wang and Alkire (2010) also use MPI methodology to measure poverty between different regions from eight dimensions by analyzing CHNS data. These two papers do not attempt to measure child poverty, but they provide useful references, although the methodology they use to select and combine deprivation indicators has been criticised as being arbitrary and lacking in scientific rigor (Gordon and Nandy, 2012).

II Methodology and Data

2.1 Deprivation Dimensions and Indicators

The deprivation indicators used in this study are mainly based on previous child poverty research in China as well as the universal agreed human rights and development goals, such as UNCRC (UNCRC, 1989) and MDGs (MDGs, 2003). For each domain, we develop several deprivation indicators and thresholds using the relevant MDG threshold criteria (MDGs, 2003), international child poverty/deprivation studies and previous research on child poverty in China. For example, It is recognized in the CRC that children should have access to 'environmental sanitations' (Article 24) and also recognized by child poverty research that children without access to sanitation facilities are deprived (Nandy and Gordon, 2009). So, we include sanitation facilities as one of our material deprivation dimensions. Under this domain, two indicators of toilet facilities and unprocessed solid cooking fuel are developed. Poor toilet facilities have been used widely as one deprivation indicator of child poverty according to several international as well as domestic poverty studies (Gordon et al., 2003; Nandy, 2010; Wang and Shang, 2011; Zou and Fang, 2011). Article 29 of MDGs (2003) argues that the use of unprocessed solid fuels (e.g. dung and crop residues, wood, charcoal and coal) for cooking and heating in the household exposes children to indoor air pollution which can lead to serious respiratory health problem. In order to define deprivation threshold for the two indicators, we firstly examine deprivation threshold developed for poverty research in China and then to other international research. For toilet facilities, Zou and Fang (2011) define a deprivation threshold in the context of China as households without flush, in-house toilet facilities. So, this definition is used in this paper.

Another important issue in selecting deprivation indicator list is to consider comparability and consistency across different years and between different regions. An indicator should be relevant and measured consistently across time and space. To facilitate comparisons between different regions, deprivation indicators should represent a basic living standard that children in China should have wherever they live. We don't include items which are only applicable to certain regions and areas. For example, air conditioner or an electric fan is considered as a necessary item in some areas of China with very high temperatures in summer, such as Southern

China. However, in Northern provinces (e.g. Heilongjiang) which normally have a relative cool weather in both summer and winter, it is common to have heaters at home rather than air conditioning or fans. Thus we did not include air conditioning or electric fans as they are not necessities in all parts of China. In order to facilitate comparisons across time periods from 1989 to 2009, indicators should reflect changing living patterns over time. For example, Black/White TV is much more common in the 1990s while colour TV is popular after 2000. These two indicators have quite similar function in providing information for children, so children are only deprived if they could not access to either Black/White TV or Colour TV (i.e. these indicators are substitutable). Similarly, bicycle and motorcycle are normally used as basic transportation tools for short-distance travel. So, children are only deprived of basic transport if they could not access either a bicycle or a motorcycle. The final list of deprivation indicators is also influenced by data availability and accessibility. For example, food deprivation indicators such as fresh vegetables, meat at least twice a day are used to measure child poverty in both UK and EU (Notten and Roelen, 2010; Gordon et al., 2000a; Guio, et al., 2012). An attempt was made to include these indicators under food/nutrition dimension but food codes and food names are not available in the current dataset. So, children are only considered to be deprived of food access if they don't have three meals a day. Table 1 provides details of the full list of the deprivation indicators and thresholds as well as the related questions in the CHNS dataset.

Table 1 Material Deprivation Dimensions- Indicators

Dimensions	Indicators	Theoretical Reason (Sources)	Deprivation Indicator Cut-offs /Threshold	Questions/Information in the Survey
Food / Nutrition	*1.Three meals a day*	Three meals a day is a social norm which has been used to measure deprivation in previous research (Gordon et al., 2000; Pantazis, et al., 2006)	Deprived if children don't have three meals a day;	Over a three day period, do children have their breakfast, lunch and dinner, every day?
	2.Stunting (height-for-age) *3.Underweight (weight-for-age)*	Child malnutrition is widely researched and strongly associated with child poverty. (Gordon et al., 2003)	Children whose heights and weights for age and gender are two standard deviations below the norm of the WHO international reference child growth standards. WHO has set standards for stunting for children up to 19 years old and underweight for children up to 10 years old (WHO, 2006).	Children's Weight and Height were provided in physical examination part of Children's questionnaire Age and gender specific: stunting <18 years old and underweight <10 years old.
Water	*4.Improved water source*	Water is a biological necessity for children and adults. Unimproved drinking water is harmful for children's health (MDGs, 2003)	Deprived if children can't obtain tap water or in-yard well (Zou and Fang, 211); or ground water from a covered well less than5 meters from the dwelling or from a water plant (Wang and Alkire, 2010)	How does HH obtain drinking water? 1.In-house tap water; 2.In-yard tap water; 3.In-yard well 4. Others What is the source of this water? 1. Ground water 2. Open well(<=5 meters) 3.creek, spring, river, lake 4.ice/snow 5.water plant
Sanitation facilities	*5.Toilet facilities in or near home*	Poor sanitary facilities such as lacking an indoor toilet have a long history of use as indicators of deprivation (Nandy, 2010)	Deprived if hh does not have a flush, in-house toilet (Zou and Fang, 2012)	What type of toilet facilities does your hh have? 0.no bathroom 1.flush, in house 2.no flush, in-house 3. Flush, outside house, public restroom 4.no flush, outside house, public restroom 5.cement openpit 6. Earth openpit

	6.Unprocessed Solid Fuel for cooking	Unprocessed solid fuels expose children to indoor air pollution, which can lead to serious respiratory health problems. (MDGs, 2003).	Deprived if hh use coal, kerosene, wood, sticks/straw, charcoal	What kind of fuel does your household normally use for cooking? 1.coal 2.electricity 3.kerosene 4.liquified natural gas 5.natural gas 6wood, sticks/straw 7.charcoal
Shelter	*7.Overcrowding*	Overcrowding is widely considered as an indicator of shelter deprivation. An international criteria for overcrowding is more than 3 people per room (UNCHS, 1996)	Deprived if hh has more than 3 people per room	Excluding the bathroom and toilet, how many rooms does your household have? (person/room)
	8.Dwelling Quality	Mud floors might cause sanitation and health problems for children and it has been used as indicators of shelter deprivation (Gordon et al., 2003)	Deprived if hh has mud floor	Of what material are the floors of this house/apartment building constructed? 1.concrete 2.brick 3.earth/mud 4.wood 5. floor board, wood 6 floor board, wood, man-made 7 floor board, plastic
	9.Electricity	Electricity is very important for children and has been used to measure poverty in china (Alkire and Wang, 2010; Zou and Fang, 2012)	Deprived if hh does not have electricity	What kind of electricitying does your household normally use? 1.electric 2. Kerosene 3. Oil 4. Candle
Education	*10.Not currently attending school*	Education is a key determinant of children's wellbeing and a basic human right included in the CRC (UNCRC, 1989; Nandy, 2010)	Deprived if children are not currently in school	Currently in school? Age specific: for children from 6 to 15 years old 0.no 1.yes

Health	*11.Immunization*	Immunization is a key means to prevent infection and reduce child mortality (MDGs, 2003).	Deprived if children is not immunized	Any immunization shots past 12 months? Age specific: for children under 2 years old (24 months) 0.no 1.yes
	12.Needed Medicines/Drugs	Access to medicine when needed is clearly important for health (MDGs, 2003)	Deprived if needed medicine is not available	Needed medicines generally available? 0.no 1.yes
Information	*13.TV:Black/White TV or Colour TV* *14. Computer* *15. Telephone* *16. Cell phone*	Access to information is one of children's participation rights (UNCRC, 1989).	Deprived if hh do not have at least one of these items	Does hh own Black/White TV, Colour TV, Computer, Telephone and Cell phone? 0.no 1.yes
Consumer Durables	*17. Washing machine* *18. Refrigerator* *19.Transport:* *Bicycle or Motorcycle* *20. Car*	Ownership of consumer durables is informative of a household's socio-economic status and they facilitate people's daily lives and promote quality of life (Laura, 2008).Theses items have been used by Chinese scholars to measure poverty in China (Zou and Fang, 2012)	Deprived if hh does not have these items	Does hh own a Washing machine, Refrigerator, Bicycle, Tricycle, Motorcycle and car? 0. no 1.yes
Leisure Activities	*21.Indoor activities* *22.Outdoor activities*	Children have the rights to relax and play, and enjoy different kinds of indoor or outdoor activities (UNCRC, 1989).	Deprived if children can't do indoor activities Deprived if children can't do outdoor activities	Do you participate in this activity? (as activities in the questionnaire are too detailed, so they are aggregated into indoor and outdoor activities) Age Specific: Under 6 and 7-18

2.2 Research Methodology

It is important that deprivation indicators are valid, reliable and additive. The methodology to choose valid, reliable and additive indicators is mainly based on the work of Gordon (2006), Gordon and Nandy (2012) and Guio et al (2012). Firstly, to be a valid index component of deprivation, items should distinguish between the deprived and those not deprived, which is the most essential requirement of the three. Equivalised household income may be employed as an external test of validity for a child deprivation indicator, deprived children should live in households with a lower equivalised income than their non-deprived peers. Income has been deflated/equivalised (adjusted for household size) using the recent OECD method (OECD, 2009) - the square root of the household size. Statistically we use ordinary least square regression model (OLS) to conduct this analysis with the equivalised income as the dependent variable and the material deprivation indicator dummies as independent variables separately. A household with children suffering from deprivation is likely (all things being equal) to have a lower income on average than a household where the children are not deprived.

Secondly, the index of material deprivation also has to present a consistent and repeatable measurement of poverty. In this paper, we use the Classical Tests Theory model (Nunally, 1978) and calculate Cronbach's Alpha to test the internal consistency of all items in an aggregated deprivation index. If removing one indicator results in an increased Alpha value for the deprivation index, the indicator can be regarded as an unreliable item.

Finally, in addition to validity and reliability, all selected indicators should also satisfy the criterion of additivity. Since the deprivation index contains several deprivation items, it is a requirement that they should sum i.e. that those suffering from two deprivations are more deprived than those suffering from only one deprivation, etc (Guio et al, 2012). In this study, we test the impact of any two MD items (X1 and X2) on the equivalised household income (Y), using the same equivalence scale as the validity test, which contains both first order main effects (β1 and β2) and the interactive effect of the two items (β3) as shown in the equation below.

$$Y=\alpha+\beta1X1+\beta2X2+\beta3X1X2 \quad (1)$$

There are four possible combinations for children deprived or not deprived of each of the two items, and the following equations express their different equivalised income

$$\begin{cases} Y = \alpha \text{ if } X1 = 0 \text{ and } X2 = 0 \\ Y = \alpha + \beta1 \text{ if } X1 = 1 \text{ and } X2 = 0 \\ Y = \alpha + \beta2 \text{ if } X1 = 0 \text{ and } X2 = 1 \\ Y = \alpha + \beta1 + \beta2 + \beta3 \text{ if } X1 = 1 \text{ and } X2 = 1 \end{cases}$$

The following conditions will satisfy the additivity requirement of an index item, i.e. those suffering from one deprivation are more deprived than those who do not suffer from any deprivations, and those suffering from two deprivations are more deprived than those suffering from only one deprivation. Indicators are deleted if they are not additive.

$$\begin{cases} \alpha > \alpha + \beta 1 \\ \alpha > \alpha + \beta 2 \\ \alpha + \beta 1 > \alpha + \beta 1 + \beta 2 + \beta 3 \\ \alpha + \beta 2 > \alpha + \beta 1 + \beta 2 + \beta 3 \end{cases}$$

Therefore, the final conditions shown below contain two negative deprivation gradients (β1 and β2) and two additional conditions of negative linear combination of the coefficients.

$$\begin{cases} \beta 1 < 0 \\ \beta 2 < 0 \\ \beta 2 + \beta 3 < 0 \\ \beta 1 + \beta 3 < 0 \end{cases}$$

Statistically, we estimate the parameters of β1, β2 and β3 based on the General Linear Model shown in equation (1), and conduct an F test for the linear combination of the coefficients. Additive items should provide a significantly negative linear combination.

2.3 Data Description

This paper uses China Health and Nutrition Survey (CHNS) data to carry out the statistical analysis for the following reasons. Firstly, and most importantly, it is a purpose of this paper to measure children's multidimensional poverty and deprivation, which requires a rich dataset that covers different dimensions of children's living conditions. Secondly, this paper attempts to compare children's living conditions across different years and between different regions. So, the dataset should cover a long time period and include various regions. Some datasets provide rich information on children's living conditions, but there is only one year or a few years of data, such as *1992 Sample Survey of the Situation of Children in China* (Cook and Keeley, 2007). While, some datasets have data in different years but only cover certain areas, such as the *Urban Household Survey* or the *Rural Household Survey* (Cook and Keeley, 2007). The *Chinese Household Income Project Survey (CHIP)*[5] is a commonly used dataset for studies of poverty and inequality, but it does not contain much direct information on children's living conditions. The CHNS dataset is the only one currently available that both covers a long time period from 1989 to 2009 in rural and urban areas and provides rich information on various aspects of children's living conditions.

The CHNS dataset includes cross-sectional and longitudinal panel data[6]. The first survey was in 1989, followed by subsequent waves in 1991, 1993, 1997, 2000, 2004, 2006, 2009. It is a multi-stage longitudinal sample design, with random sample of about 4,400 households and 19,000 individuals. CHNS survey data includes a household survey, adult survey, child survey for all children aged 0 to 18, nutrition survey and community survey. It collects information on household characteristics such as housing, toilet facilities, drinking water source, cooking fuel, electricity, nutrition and diet, health conditions, community infrastructure and facilities, children's indoor and outdoor activities, etc. It is a very rich dataset which facilitate the development of

[5] It covers both rural and urban areas in 1988, 1995 and 2002, from http://www.icpsr.umich.edu/icpsrweb/ICPSR/series/243
[6] Details of CHNS are available at CHNS official website: http://www.cpc.unc.edu/projects/china

deprivation indicators.

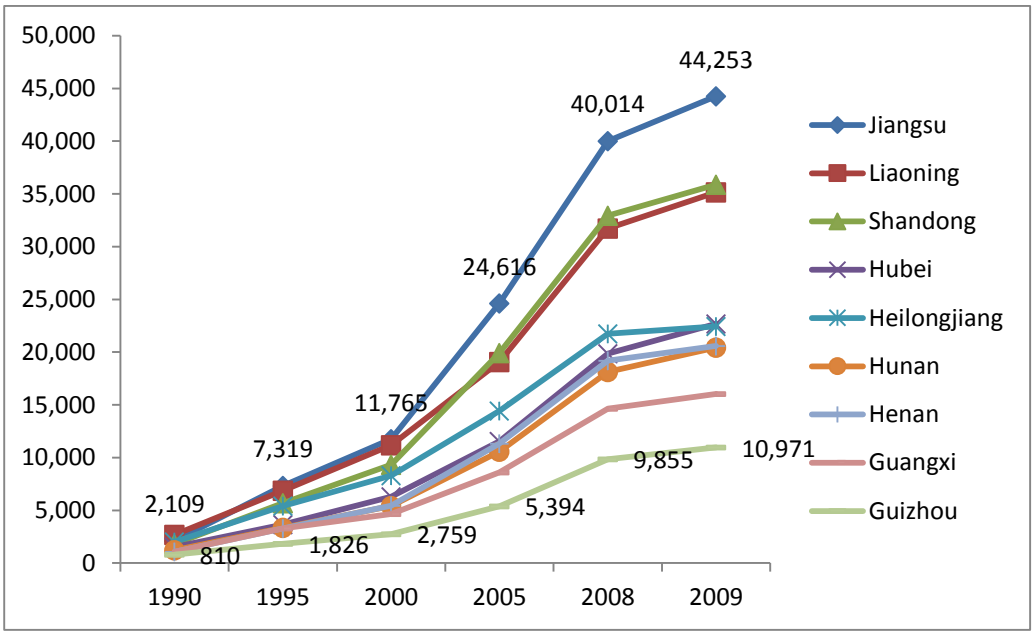
Figure 1: Provinces included in the China Health and Nutrition Survey

Source: China Health and Nutrition Survey [7]

There are in total nine provinces included in the dataset, which cover Heilongjiang, Liaoning, Shandong, Jiangsu, Henan, Hubei, Hunan, Guizhou and Guangxi[8]. Figure 1 shows the location of the nine provinces. Although there are only nine provinces included in the CHNS survey, it covers four regions of Mainland China, which are the North-Eastern, Eastern, Middle and the Western areas[9]. Heilongjiang and Liaoning are located in the North-Eastern China, Shandong and Jiangsu belongs to Eastern China, Guizhou and Guangxi is within Western China and the Henan, Hubei and Hunan are in the Middle regions of China.

[7] Map is from the CHNS official website http://www.cpc.unc.edu/projects/china/proj_desc/chinamap
[8] In 1997, Heilongjiang province replaced Liaoning province and in 2000, Liaoning province was again included in the study.
[9] None of these provinces are in the North Western sub-region of Western China.

Figure 2 Per Capita GDP changes over time from 1990 to 2009 by provinces in RMB



Source: National Bureau Statistics, China[10].

The nine provinces have quite different geographical conditions and levels of socioeconomic developments. Figure 2 presents the GDP per capita from 1990 to 2009, which varied significantly between the nine provinces. Jiangsu, for example, located in the Eastern regions of China, is the most developed province with the highest GDP per capita in all the years after 1990. In the ranking of GDP per capita by provinces, Jiangsu is always in the top 5. Per capita GDP of Jiangsu province in 1990 was RMB 2, 109 and increased to RMB 44, 253 in 2009. By contrast, Guizhou, in the Western regions, is the poorest and least developed province in the whole China with the lowest GDP per capita from 1990 (RMB, 810) to 2009 (RMB, 10,971). The disparity ratio of Jiangsu and Guizhou provinces in per capita GDP has increased over time (2.6 times in 1990 to 4 times by 2009). The main deficiency of CHNS dataset is that it only covers nine provinces and has a relatively small sample size. The relatively small number of sample locations and the small sample size may result in unreliable estimates when comparing regional disparities.

[10] http://www.stats.gov.cn/english/

III Results and Discussion

3.1 Statistical Test Results[11]

Table 2 Validity Test Result from 1989 to 2009

Indicators	1989	1991	1993	1997	2000	2004	2006	2009
1.Stunting	X	√	√	√	√	√	√	√
2.Underweight	√	√	X	X	√	X	√	√
3.Water	√	√	√	√	√	√	√	√
4. Toilet	√	√	√	√	√	√	√	√
5. Fuel	√	√	√	√	√	√	√	√
6. Roompp	X	√	X	X	X	X	-	√
7. Floor	√	√	√	√	√	X	X	-
8. Electricity	X	√	√	√	X	X	X	X
9. School	√	√	√	√	√	X	X	X
10.Immunisation	-	X	X	√	-	X	-	-
11.Medicine	X	X	X	X	X	X	-	-
12.TV	√	√	√	√	√	√	X	√
13. Computer	-	-	-	√	√	√	√	√
14.Telephone	-	-	-	√	√	√	√	√
15.Cellphone	-	-	-	-	-	√	√	√
16. Washing	√	√	√	√	√	√	√	√
17. Refrigerator	√	√	√	√	√	√	√	√
18. Transport	√	√	√	√	X	√	√	X
19. Car	X	√	√	√	√	√	√	√
20. Indoor	-	-	-	√	X	X	-	-
21. Outdoor	-	-	-	X	√	X	-	-

Table 2 presents the results of the validity test for each wave of the CHNS survey from 1989 to 2009. Detailed regression results are in the Appendix. Five items are valid indicators of child poverty across all the wave years, including water, toilet, refrigerator, washing machine and fuel. Equivalised household income has a significant influence on these five items across different years. It means that children who live in a poorer family are more likely to be deprived of these five essential items. With the exception of 2006, TV is a valid indicator across all the waves. Car and stunting, are also valid items in all the other waves, with the exception of 1989. Immunisation, medicine, roompp, indoor and outdoor activity are invalid indicators of deprivation in all waves. Some items pass validity tests for certain years. For example, floor is a valid item to measure child poverty in the early waves from 1989 to 2000. By contrast, computer, telephone and cell phone, as new invented products, are valid in recent wave years after 1997 and 2004 respectively.

[11] 100% children have three meals a day in CHNS survey, so this item is not included.

Table 3 Reliability Test Result from 1989 to 2009

Year	1989	1991	1993	1997	2000	2004	2006	2009
All Items	**0.7098**	**0.7238**	**0.7032**	**0.7634**	**0.7798**	**0.7382**	**0.7307**	**0.6618**
1.Stunting	0.6975	0.7176	0.6949	0.7604	0.7751	0.7359	0.7225	0.6609
2.Underweight	0.699	0.7128	0.6954	0.7584	0.7726	0.7288	0.7182	0.6533
3.Water	0.6702	0.7052	0.6944	0.7568	0.7753	0.7329	0.7245	0.6488
4.Toilet	0.6948	0.7008	0.6662	0.7309	0.7453	0.7039	0.6937	0.6284
5.Fuel	0.6994	0.6969	0.6577	0.7217	0.7489	0.7016	0.6968	0.6412
6. Roompp	**0.7129**	**0.7322**	0.6922	0.7603	0.7762	0.7302	**0.7307**	**0.6635**
7. Floor	0.6671	0.6919	0.692	0.7618	0.7754	**0.7345**	0.7222	
8. Electricity	0.702	**0.7247**	**0.709**	**0.7702**	**0.7865**	**0.7444**	**0.736**	**0.6668**
9. School	**0.7475**	**0.7402**	**0.7274**	**0.7757**	**0.7875**	**0.7431**	**0.7399**	**0.6678**
10.Immunisation	**0.7098**	-	-	-		-	-	-
11.Medicine	0.6969	0.7118	0.6896	0.7542	0.771	**0.7382**	**0.7307**	-
12.TV	0.6476	0.6841	0.67	0.7563	0.7751	0.7329	0.7298	0.6591
13.Computer	-	-	-	**0.7677**	**0.7847**	0.7323	0.7148	0.6081
14.Telephone	-	-	-	0.7175	0.7303	0.7055	0.703	0.6417
15.Cellphone	-	-	-	-		0.7026	0.698	0.6373
16.Washing	0.6561	0.6713	0.6408	0.7239	0.7458	0.7084	0.6048	0.6191
17.Refrigerator	0.6942	0.6902	0.6547	0.7158	0.7307	0.6825	0.678	0.5971
18.Transport	0.703	0.7172	**0.7034**	**0.7762**	**0.7943**	**0.7536**	**0.7448**	**0.6743**
19.Car	**0.7209**	**0.7299**	**0.7144**	**0.7678**	**0.7861**	**0.7438**	**0.7336**	0.6599
20.Indoor	-	-	-	0.7534	0.7706	-	-	-
21.Outdoor	-	-	-	0.7541	0.7711	-	-	-

Table 3 shows the Cronbach's alpha values of the child deprivation indicators for all waves of the CHNS survey and includes those items that failed the validity tests. The alpha value is higher than 0.7 in all waves except 2009, which is a satisfactory result of the underlying construct of these child deprivation items (Nunally, 1978). Items are considered to be unreliable if they increase the alpha value of the deprivation scale when they are omitted. For example, the indicators of electricity, school, immunisation, transport and car are unreliable in all waves, as they increase the alpha value when they are omitted. By contrast, stunting, underweight, water, toilet, fuel, TV, washing machine and refrigerator are reliable items for all the waves, deleting these items would decrease the overall reliability. Some deprivation measures such as roompp, floor, medicine and computer do not pass the reliability test in some years.

Figure 3 Additivity Test Results-Two examples

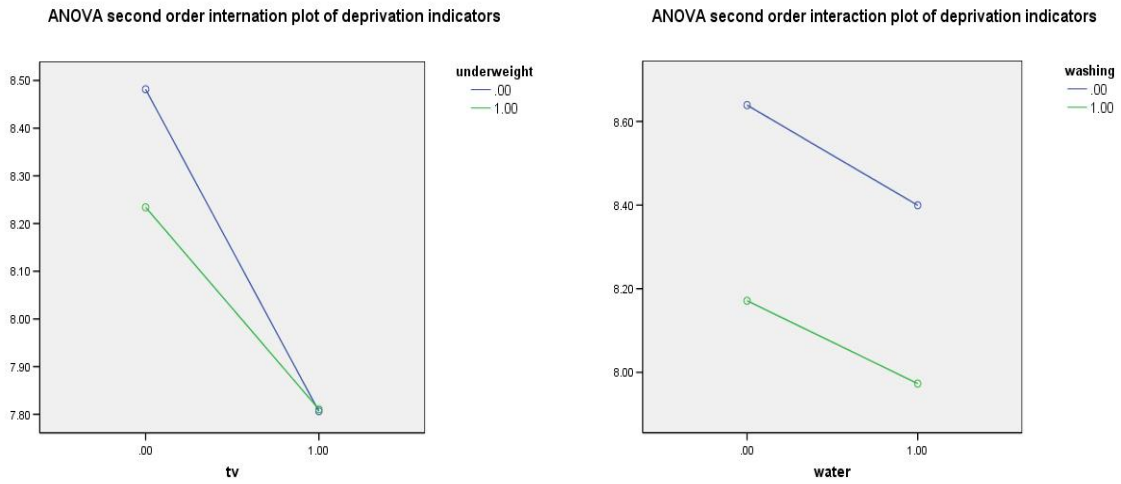


Figure 3 is a second order interaction plots from an ANOVA analysis. Additivity test result shows that 'Indoor' and 'Outdoor' have additive problems with four other items in 1997 and 2000, 'Underweight' with other 5 items in 1997 and 4 items in 2000, 2006 and 2009, 'TV' has additive problems with four other items in 1989, five items in the 2000 and 2004, and with six other items in 2009, 'Car' has additive problems with six items in 2009. Therefore, these five indicators do not pass the additivity tests as they have more than 3 interaction problems with other items. Figure 3 shows two examples of the interaction plot results. The first graph shows that the two lines intersect which indicates TV and underweight have additive problem. It shows that children deprived of TV and children who are underweight are not poorer than children only deprived of TV or underweight. The result of F test based on the regression also shows that these two indicators are not additive, because $\beta 1$ (TV)$+\beta 3$ and $\beta 2$ (underweight) $+\beta 3$ are not significantly less than 0, which means children who suffer two deprivation items do not have a significantly lower household income compared with children suffering from just one of these deprivations. The second graph of Figure 3 shows that the two lines decrease from top left to bottom right and there is no intersection. This means that children who are simultaneously deprived of water and a washing machine live in a poorer family than those who are deprived of only water or a washing machine, and furthermore children who are deprived of only one of these items are poorer than those with no deprivations. The F test result show a significant difference at the 5% level that $\beta 2$ (water) $+\beta 3<0$ and $\beta 1$ (washing machine) $+\beta 3<0$, which again demonstrates that these two items are additive.

Table 4 Changes on the list of deprivation items over time

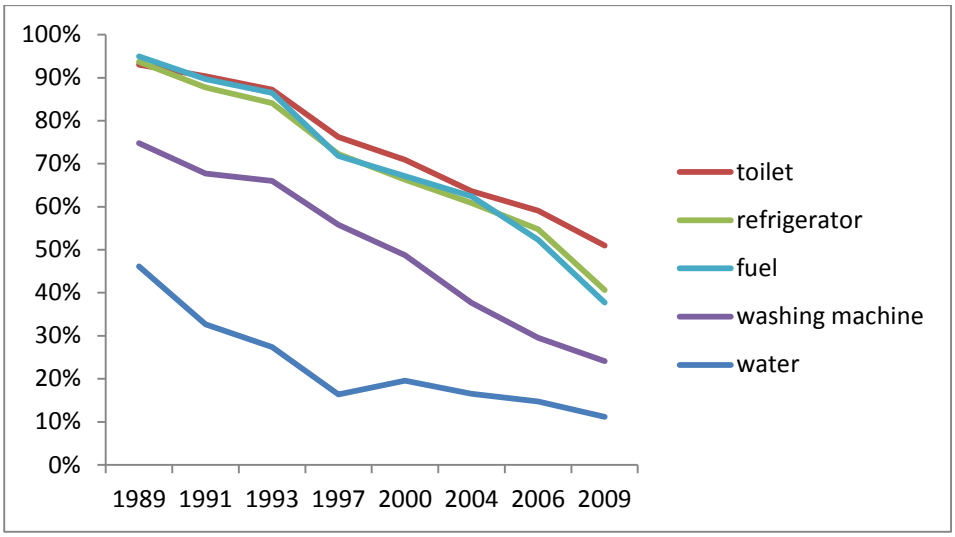
1989	1991	1993	1997	2000	2004	2006	2009
Water	Water	Water	Water	Water	Water	Water	Water
Toilet	Toilet	Toilet	Toilet	Toilet	Toilet	Toilet	Toilet
Refrigerator	Refrigerator	Refrigerator	Refrigerator	Refrigerator	Refrigerator	Refrigerator	Refrigerator
Washing Machine	Washing Machine	Washing Machine	Washing Machine	Washing Machine	Washing Machine	Washing Machine	Washing Machine
Fuel	Fuel	Fuel	Fuel	Fuel	Fuel	Fuel	Fuel
	TV	TV	TV	-	-	-	-
Floor	Floor	Floor	Floor	Floor	-	-	-
-	-	-	Telephone	Telephone	Telephone	Telephone	Telephone
-	-	-	-	-	Computer	Computer	Computer
-	-	-	-	-	Cell phone	Cell phone	Cell phone
-	Stunting	Stunting	Stunting	Stunting	Stunting	Stunting	Stunting
Transport	Transport	-					
Underweight	Underweight	-					

The deprivation items which pass the validity, reliability and additivity tests are good indicators to measure child poverty in China. Table 4 shows the change of the deprivation index from 1989 to 2009. Some items are valid, reliable and additive for all the years, such as water, toilet, refrigerator, washing machine, fuel. The other items are good indicators for some years, for example floor is a good deprivation item from 1989 to 2000. With the exception of 1989, stunting is a good deprivation indicator in all the waves – this result is likely to be a statistical artefact resulting from random sampling error and multiple tests i.e. at the 5% level an incorrect results (false positive or negative) will occur once for every 20 significance tests. Telephone, cell phone and computer are good items to measure child poverty in more recent years after 1997 and 2004 respectively. The change in the deprivation index reflects both technological changes and also changes in average consumption pattern over time.

3.2 Discussion

The valid, reliable and additive items are used as independent indicators to measure the changing pattern of children's living conditions and how they varied between different regions. It's not the attempt to sum up a poverty index using these items and thus, this part will purely explore how child deprivations on each item change over time and across regions. Figure 4 presents the general trend in child deprivation from 1989 to 2009 for five deprivation items, toilet facilities, refrigerator, unprocessed solid cooking fuel, washing machine and water.

Figure 4 General trends on child deprivations over time from 1989 to 2009



In general, from 1989 to 2009, child deprivation in China decreased, which means that children's general living conditions improved during the decades that China experienced significant socioeconomic reforms. The most prevalent deprivations in 1989 were the use of unprocessed solid cooking fuel (95%), lacking adequate sanitation facilities (93%) and a refrigerator (94%). Three out of four children (75%) and almost half (46%) of all children were deprived of a washing machine and safe drinking water respectively. By 2009, there had been significant declines in the proportions of children deprived of fuel (38%), sanitation facilities (51%) and refrigerator ownership (41%). The proportion of children who are deprived of washing machine and water also declined to 24% and 11%. Shelter deprivation fell from 38% in 1989 to 10% in 2000. Stunting decreased from 27% in 1991 to 8% in 2009. There was also a drop of information deprivation (75% lacked a telephone in 1997, this fell to 47% in 2009), cell phone (48% in 2004 to 11% in 2009) and computer (92% in 2004 to 76% in 2009).

Figure 5 Rural-Urban Disparities in child deprivation in 1989

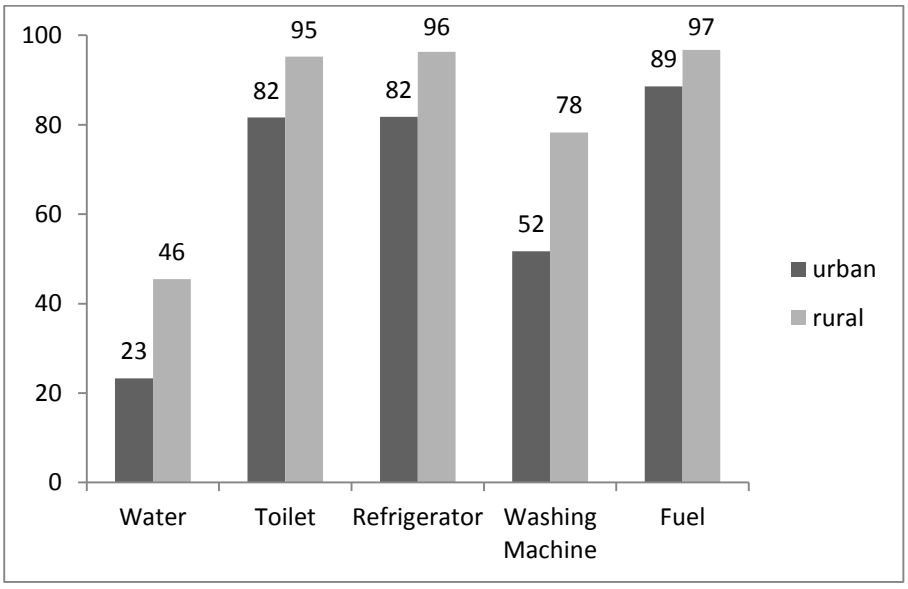


Figure 6 Rural-Urban Disparities in child deprivation in 2009

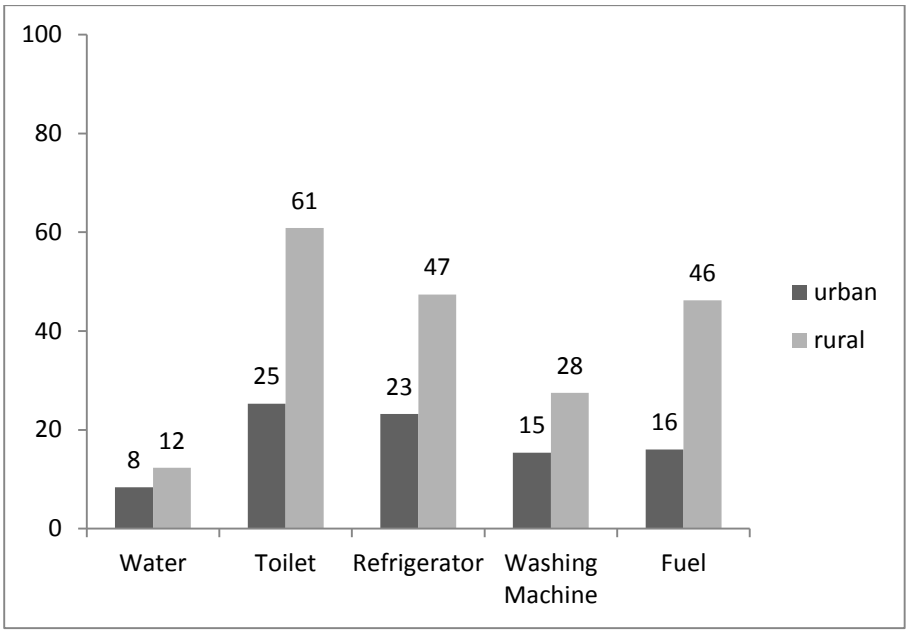
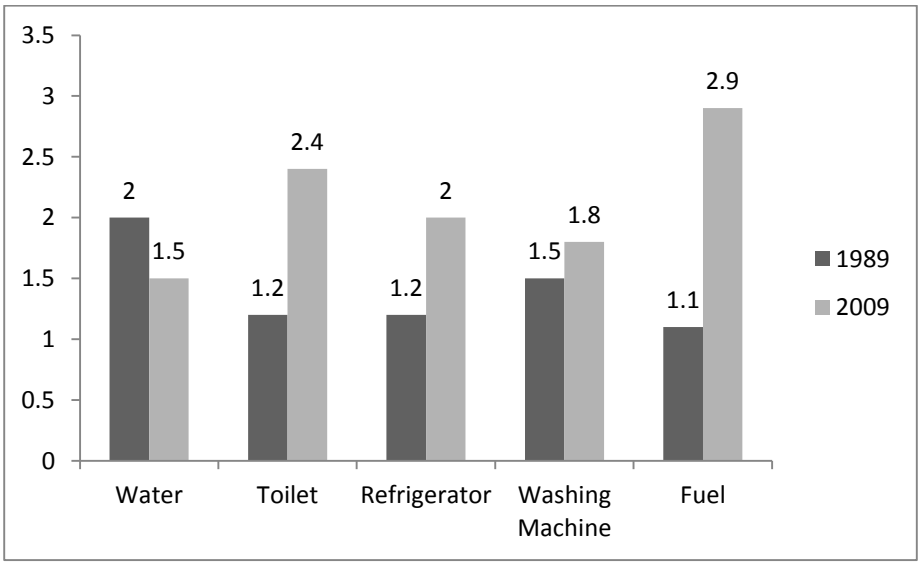


Figure 5 and Figure 6 present a comparison between child deprivations in urban and rural areas in 1989 and 2009. The result of Chi square test shows a significant p value<0.05 for the five items in both 1989 and 2009. In general, deprivation declined between 1989 and 2009 in both urban and rural areas.

Figure 7 Rural-urban ratios of child deprivations in 1989 and 2009



However, the disparities between urban and rural areas in children's material living conditions have increased over time. Figure7 shows the rural-urban ratios of deprivation of material living conditions in 1989 and 2009. The greatest rural-urban disparities in 1989 were for water (2) and washing machine (1.5). The disparities in 2009 only declined for water (2.0 to 1.5). Disparities increased for the other four items, toilet deprivation (1.2 to 2.4), refrigerator (1.2 to 2.0), washing machine (1.5 to 1.8) and fuel (1.1 to 2.9). This result shows that rural-urban disparities on processed solid cooking fuel are greatest in 2009. Rural-urban disparities also increased for the other items over time, such as computer (1 in 1997 to 1.4 in 2009), telephone (1.4 in 1997 to 1.5 in 2009)

and floor (1.8 in 1989 to 2.1 in 2000). These results all suggests that rural-urban disparities in China were significant in 1989 and had become increasingly more severe by 2009.

Figure 8 Regional Disparities in Child deprivations in 1989

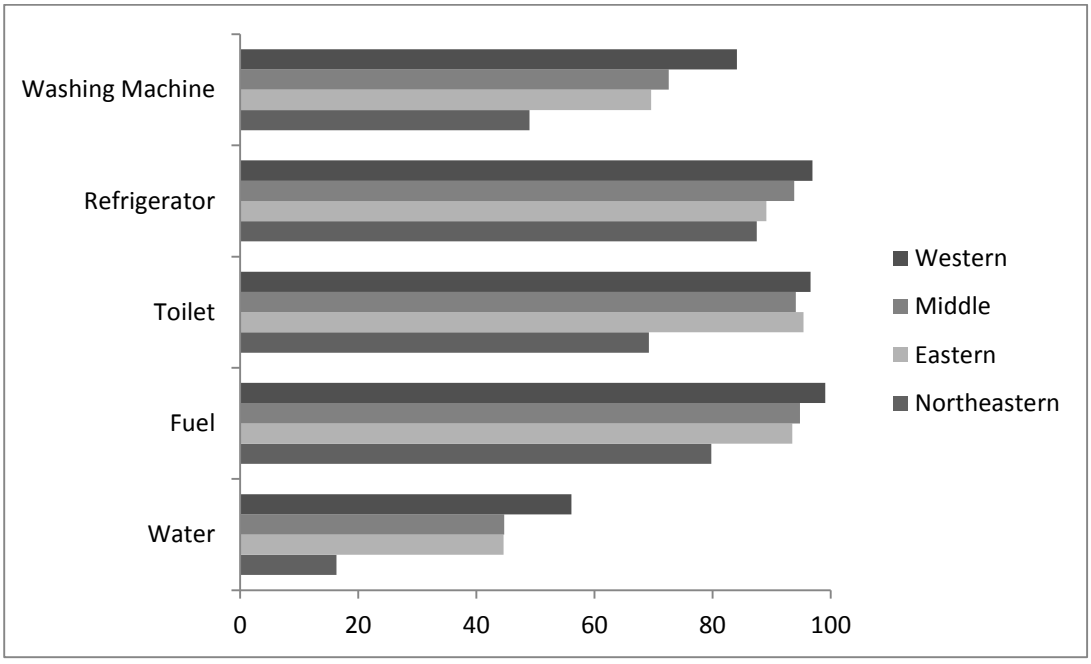
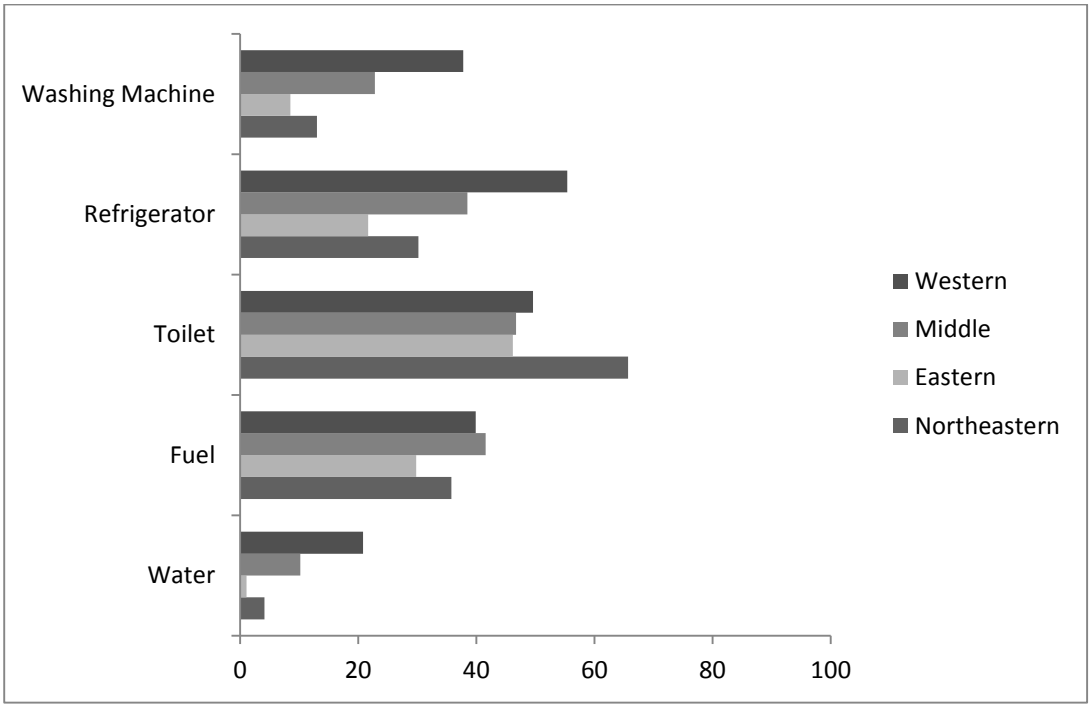


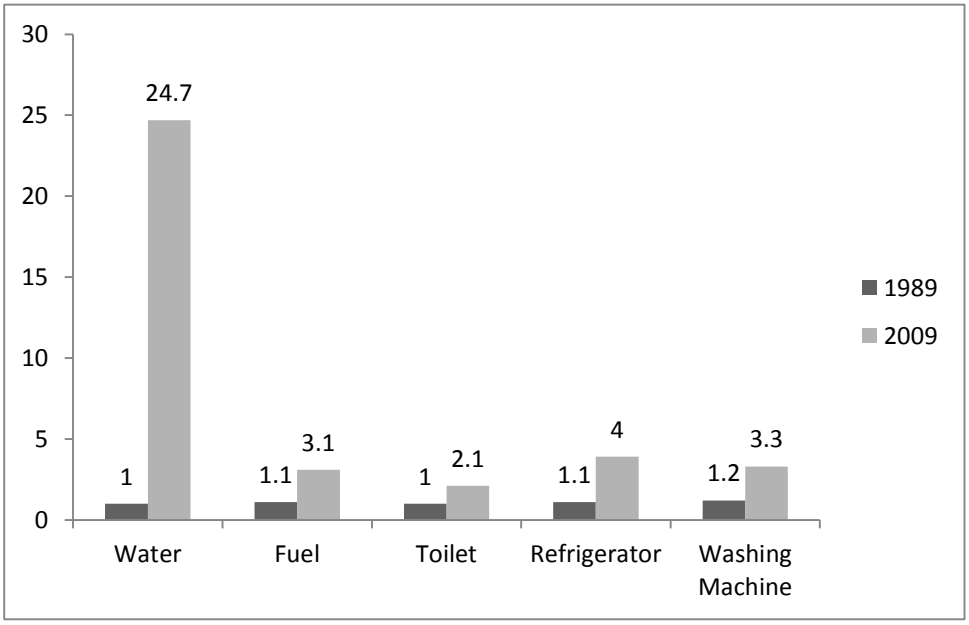
Figure 9 Regional Disparities in Child deprivations in 2009



In addition to rural-urban disparities, there are also significant disparities in child deprivation by region. As previously discussed, Heilongjiang provinces replaced Liaoning provinces in the 1997 wave and Liaoning province was included again in 2000. There are no data for Heilongjiang province from 1989 to 1993Consequently, in comparing regional disparities among the four classified regions in 1989, data from eight

provinces except Heilongjiang are used to make this comparison. While for the wave year 2009, all the nine provinces are included in the comparison. Figure 8 and Figure 9 present four regional disparities in child deprivation for five items in 1989 and 2009. Child deprivations, on the whole, have declined over time across the four regions. However, regional disparities have increased significantly. In 1989, the proportions of child deprivations were greatest in the Western region and least in the North-Eastern region. In general, there were no big differences between Western, Middle and Eastern regions for toilet (97: 94: 95), refrigerator (97: 94: 89) and fuel (99: 95: 94). However, by 2009, the disparities especially among Western and Eastern regions had increased significantly. For example, , one in four children (21%) in 2009 in the Western region were deprived of access to safe drinking water and this was around 20 times more child water deprivation than in the Eastern region (only 1%). For other deprivations items, such as fuel (40:30), refrigerator (55: 22), washing machine (38: 9), regional disparities between Western and Eastern regions also increased. For information deprivation, such as telephone the level of disparity was 1.3 in 1997. By 2009, the disparity ratio increased from 1.3 to 2.6 even though telephone deprivation declined in all regions. These results all shows that regional disparities increased over time in China.

Figure 10 Guizhou-Jiangsu Ratio on child deprivations by 1989 and 2009



It is also interesting to compare the most affluent Eastern province Jiangsu with the least developed Western province Guizhou. Figure 10 shows the ratios of Guizhou-Jiangsu child deprivations in 1989 and 2009. Jiangsu and Guizhou had similar levels of child deprivation at the beginning of 1990s but the gap had increased sharply by 2009. The greatest disparities are now for safe drinking water (1.0 to 24.7). Disparities also increased for unprocessed solid cooking fuel (1.1 to 3.1), toilet facilities (1 to 2.1), refrigerator (1.1 to 4) and washing machine (1.2 to 3.3). There is also an increase in the disparity ratio for telephone deprivation (from 1.5 in 1997 to 5 by 2009) and computer deprivation (from 1.1 by 2004 to 1.8 by 2009). The Guizhou-Jiangsu disparity also increased for the proportions of stunted children. In Guizhou, 45% of children were stunted in 1989 and this decreased to 19% in 2009, while in Jiangsu the decrease was from 18% and 4%. However, the Guizhou-Jiangsu disparity ratio for stunting increased from 2.5 to 5. The results show that regional disparities in child deprivation

are significant and have increased over time.

IV Significance and Limitations of Current Study

This study is the first attempt to measure child poverty in China across time and region using a multidimensional deprivation approach. It helps to fill the significant gap in the literatures on child poverty in China. Firstly, this study utilizes a multidimensional deprivation approach to measure children's material living conditions; secondly, this study uses statistical methods to test the validity, reliability and additivity of the child deprivation indicators for all available waves of the CHNS, between 1989 and 2009; thirdly, this work produces estimates of rural-urban and regional disparities in child deprivation.

However, this paper has several limitations. It does not measure the depth and extent of child poverty by calculating cumulative deprivation. Additionally, the CHNS data has a relatively small sample which includes only nine provinces and thus it is unlikely to provide a full picture of child poverty in China. And, no sampling weights are currently available for the CHNS dataset and further research is required to produce post stratification population weights by province and estimate the size of complex errors resulting from the survey design. In addition, the final deprivation scale only includes five valid, reliable and additive indicators. Large variations across time and regions in China may be important factors that make most indicators missing in the final scale. It may indicate that developing a deprivation scale that works for whole China and for a long time period is not possible. Further works could be tried on developing deprivation scale for a certain year (or a few years) or for one or few provinces (or few cities).

V Conclusion

This study identified a list of deprivation indicators and thresholds based on previous research on child poverty and universal agreed human rights and development goals. Statistical methods were used to test the validity, reliability and additivity of each deprivation indicator over a twenty year period (1989 to 2009). Finally, deprivation indicators were used to explore how child deprivations changed across time and space in China. In conclusion, children's living conditions in China improved significantly between 1989 to 2009, however, rural-urban and regional disparities increased. In the 21st Century the rural urban disparities in the use of unsafe cooking fuel increased markedly as did regional disparities in access to safe drinking water. In general, children living in the 'poor' Western region and in rural areas are much more likely to be deprived compared with children in Eastern urban areas. One explanation of this disparity is that economic development has been unbalanced between rural-urban areas and Western-Eastern regions during the last three decades. Consequently, it is important to promote economic growth and basic infrastructure development in poor regions in order to reduce child poverty and promote children's wellbeing in China. A comprehensive anti-poverty policy focused on children and their families is needed to help poor children benefit further from the rapid increase in wealth that China is experiencing.

Acknowledgement

This research uses data from China Health and Nutrition Survey (CHNS). We thank the National Institute of Nutrition and Food Safety, Chinese Centre for Disease Control and Prevention, Carolina Population Centre, the University of North Carolina at Chapel Hill, the NIH (R01-HD30880, DK056350, and R01-HD38700) and the Fogarty International Centre, NIH for financial support for the CHNS data collection and analysis files since 1989 and both parties plus the China-Japan Friendship Hospital, Ministry of Health for support for CHNS 2009. The authors are also grateful to two referees for their helpful comments on the earlier versions of this paper and to one of the author's supervisor, Professor David Gordon, for his very careful and useful comment and advice. We would also like to thank the International Society for Child Indicators Research (ISCI) and European Science Foundation (ESF), to support grants for the author to make a presentation of this paper in Heidelberg, Germany.

References

Alkire, S. (2008) Choosing dimensions: The capability approach and multidimensional poverty. In Kakwani, N. and J. Silber (Eds.) *The Many Dimensions of Poverty*. New York, Palgrave Macmillan.

Alkire, S. and J. Foster (2008) 'Counting and Multidimensional Poverty Measurement', *OPHI Working Papers No. 7*, Oxford, Oxford University.

Atkinson, T., B. Cantillon, E. Marlier, and B. Nolan (2002) *Social indicators: The EU and Social Inclusion*. Oxford University Press, Oxford.

Cook, S. and Keeley, J. (2007) *Micro-data scoping study-China*, report submitted to ESRC. Accessed online at: http://www.esrc.ac.uk/_images/China_tcm8-5137.pdf

Gordon, D., Levitas, R., Pantazis, C., Patsios, D., Payne, S., Townsend, P., Adelman, L., Ashworth, K., Middleton, S., Bradshaw, J. and Williams, J. (2000) *Poverty and Social Exclusion in Britain*, Joseph Rowntree Foundation.

Gordon, D. (2000) The Scientific Measurement of Poverty: Recent Theoretical Advances. In Bradshaw, J. and Sainsbury, R. (Eds) *Researching Poverty*, Aldershot, Ashgate. pp37-58.

Gordon, D., Nandy, S., Pantazis, C., Pemberton, S. A. and Townsend, P. (2003) *Child Poverty in the Developing World*, Bristol, The Policy Press.

Gordon, D. (2006) The concept and measurement of poverty. In Pantazis, C., Gordon, D. and Levitas, R. (Eds) *Poverty and Social Exclusion in Britain: The Millennium Survey*. Bristol, Policy Press. pp 29-70.

Gordon, D and Nandy, S. (2012) Measuring child poverty and deprivation, in Minujin, A. and Nandy, S. (eds) *Global child poverty and wellbeing, measurement, concepts, policy and action*, University of Bristol, Policy Press, pp. 57-101.

Guio, A.C., Gordon, D. and Marlier, E. (2012) 'Measuring material deprivation in the EU, indicators for the whole population and child-specific indicators', *Eurostat Methodologies and Working Papers*, Luxembourg: Publications Office of the European Union.

ICESCR (1990) The nature of States parties obligations, *CESCR General Comment 3 Article 2 (1)*, Office of the United Nations High Commissioner for Human Rights, available at: http://www.bayefsky.com/themes/adequate_general_general-comments.pdf

Laura, D.H. (2008) *The wealth index as a measure of socio-economic position*, PhD thesis: University of London.

Lau and Bradshaw (2010) 'Child well-being in the Pacific Rim', *Child Indicators Research*, 3, 3, pp. 367-383.

Lu, A. and Wei, Z. (2002) Child poverty and well-being in China in the era of economic reforms and external opening, in G.A. Cornia (ed.) *Harnessing globalization for children: A report to UNICEF* (http://www.unicef-icdc.org/research /ESP/globalisation.html).

Mack, J. and Lansley, S. (1985) *Poor Britain*, London, Allen and Unwin.

MDGs (2003) *Indicators for monitoring the Millennium Development Goals, Definitions, Rationale, Concepts and Sources*, United Nations Development Group, Accessed at: http://mdgs.un.org/unsd/mdg/Resources/Attach/Indicators/HandbookEnglish.pdf

Nandy, S. (2010) *An analysis of changes in child poverty in the developing world at the end of the 20th century*, PhD thesis: University of Bristol.

Nandy, S. and Gordon, D. (2009) 'Children Living in Squalor. Shelter, Water and Sanitation Deprivations in Developing Countries Children', *Youth & Environment*. 19, 2, 202-228.

Notten, G. and Roelen, K. (2010) 'Cross-national Comparison of Monetary and Multidimensional Child Poverty in the European Union: Puzzling with the Few Pieces that the EU-SILC Provides', *BWPI Working Paper* 135, Manchester Brooks World Poverty Institute.

Nunally, J.C. (1978) 'Psychometric theory', New York: McGraw-Hill.

OECD (2009) *What are equivalence scales?* Paris: OECD Project on Income Distribution and Poverty, available at: http://www.oecd.org/dataoecd/61/52/35411111.pdf

Pantazis, C., Townsend, P. and Gordon, D. (2006). The necessities of life, in Pantazis, C.,Gordon, D. and Levitas, R. (eds.) *Poverty and Social Exclusion in Britain. The Millennium Survey*, Bristol: The Policy Press, Chapter 4, pp. 89-122.

Pemberton, S., Gordon, D., Nandy, S., Pantazis, C. and Townsend, P. (2007) Child Rights and Child Poverty: Can the International Framework of Children's Rights Be Used to Improve Child Survival Rates? PLoS Medicine. 4(10): e307. Published online 2007 October 23. doi: 10.1371/journal.pmed.0040307

Roelen, K., Gassmann, F. and Neubourg de, C. (2009) 'The importance of choice and definition for the measurement of child poverty – the case of Vietnam', *Child Indicators Research*, 2(3), 245- 263.

State Council (2011) *Children's future development from 2011 to 2020*, State Council, available at: http://www.gov.cn/zwgk/2011-08/08/content_1920457.htm

Townsend, P. (1979) *Poverty in the United Kingdom*, Harmondsworth, Penguin Books Ltd.

UNCRC (1989) *Convention on the Rights of the Child*, New York, United Nations Department of Publications. Available at:
http://www.unicef.org.uk/UNICEFs-Work/Our-mission/UN-Convention/

UNICEF (2005) *The State of the World's Children 2005 - Childhood under threat*, New York, USA: UNICEF.

UNICEF (2009) *The State of the World's Children Special Edition*, New York, USA: UNICEF.

UNICEF (2011) *Child Poverty in East Asian and the Pacific Deprivations and Disparities-A Study of Seven Countries*, Bangkok, Thailand: UNICEF East Asian and Pacific Regional Office.

UNCHS (1996) *An Urbanising World: Global Report on Human Settlements*, Oxford, Oxford University Press.

United Nations General Assembly (2006) *Promotion and Protection of the Rights of Children-Report of the Third Committee*, New York, United Nations. UN Committee on Economic, Social and Cultural Rights (CESCR), *General Comment No. 3: The Nature of States Parties' Obligations (Art. 2, Para. 1, of the Covenant)*, 14 December 1990, E/1991/23, available at: http://www.bayefsky.com/themes/adequate_general_general-comments.pdf

UN China (2010) *China's progress towards the Millennium Development Goals*, United Nations System in China, available at: http://www.un.org.cn/cms/p/resources/30/1539/content.html

UNICEF (2010) *Atlas on children in China*, Accessed from
http://www.unicef.cn/en/index.php?m=content&c=index&a=lists&catid=60

UNICEF (2011) *Child Welfare in China-Stocktaking Report*, UNICEF, Beijing.

Wang, X.L., and Shang, X.Y. (2011) Children's access to water, sanitation facilities and fuel, in Shang, X.Y. and Wang, X.L. (eds.) *Emerging Issues and Findings for Child Welfare and Protection in China*, Social Sciences Academic Publication, pp. 211-221.

Wang, X.L. and Alkire, S. (2010) China's multidimensional poverty measurement, assessment and policy, *Report 4*, International Poverty Reduction Centre, China.

World Bank (2009) China From Poor Areas to Poor People, An Assessment of Poverty and Inequality in China,

Report No. 47349-CN, Poverty Reduction and Economic Management Department, World Bank.

WHO (2006) WHO Child Growth Standards, WHO organization, accessed from http://www.who.int/childgrowth/standards/en/

Zou,W. and Fang, Y.F. (2011) *Multidimensional Poverty in China*, accessed from http://www.sociology2010.cass.cn/upload/2012/03/d20120323131350954.pdf

Appendix

Table 1 Validity Test Regression Result for 1989

	water	toilet	floor	refrigerator	washing	fuel	light	tv
lnincome	-0.111	-0.066	-0.104	-0.070	-0.159	-0.042	-0.003	-0.195
	(5.16)**	(5.14)**	(5.07)**	(5.76)**	(8.14)**	(3.98)**	(0.27)	(9.52)**
_cons	1.291	1.448	1.175	1.488	1.999	1.285	0.103	1.992
	(7.27)**	(13.67)**	(6.93)**	(14.86)**	(12.40)**	(14.72)**	(1.05)	(11.78)**
R^2	0.04	0.04	0.04	0.04	0.08	0.02	0.00	0.11
N	701	703	701	721	721	705	705	706

* $p<0.05$; ** $p<0.01$

	transport	car	school	medicine	roompp	stunting	underweight
lnincome	-0.096	0.011	-0.062	-0.063	0.012	-0.037	-0.040
	(6.34)**	(1.82)	(2.78)**	(1.47)	(1.08)	(1.35)	(2.08)*
_cons	0.934	0.887	1.081	0.644	-0.033	0.604	0.441
	(7.45)**	(17.31)**	(5.84)**	(1.79)	(0.36)	(2.70)**	(2.75)**
R^2	0.05	0.00	0.01	0.03	0.00	0.00	0.01
N	706	705	666	78	687	379	388

* $p<0.05$; ** $p<0.01$

Table 2 Validity Test Regression Result for 1991

	water	toilet	floor	refrigerator	washing	fuel	light	tv
lnincome	-0.114	-0.088	-0.152	-0.123	-0.229	-0.103	-0.018	-0.181
	(10.46)**	(12.80)**	(14.71)**	(16.37)**	(22.18)**	(14.63)**	(4.31)**	(18.02)**
_cons	1.269	1.630	1.547	1.894	2.570	1.746	0.187	1.781
	(13.98)**	(28.51)**	(18.00)**	(30.28)**	(29.87)**	(29.85)**	(5.25)**	(21.26)**
R^2	0.03	0.05	0.06	0.08	0.13	0.06	0.01	0.09
N	3,207	3,249	3,247	3,246	3,247	3,250	3,250	3,250

* $p<0.05$; ** $p<0.01$

	transport	car	school	immunisation	medicine	roompp	stunting	underweight
lnincome	-0.081	-0.006	-0.041	0.106	0.006	-0.022	-0.080	-0.075
	(9.30)**	(2.22)*	(3.66)**	(2.33)*	(0.28)	(5.17)**	(7.29)**	(5.62)**
_cons	0.838	1.038	0.617	-0.878	0.014	0.214	0.934	0.786
	(11.58)**	(42.76)**	(6.56)**	(2.23)*	(0.09)	(6.10)**	(10.17)**	(7.16)**
R^2	0.03	0.00	0.00	0.17	0.00	0.01	0.02	0.02
N	3,250	3,231	2,790	28	250	3,244	2,901	1,263

* $p<0.05$; ** $p<0.01$

Table 3 Validity Test Regression Result for 1993

	water	toilet	floor	refrigerator	washing	fuel	light	tv
lnincome	-0.075	-0.093	-0.090	-0.117	-0.179	-0.106	-0.014	-0.108
	(8.54)**	(14.19)**	(4.95)**	(16.45)**	(19.89)**	(15.94)**	(5.59)**	(14.02)**
_cons	0.896	1.644	0.905	1.812	2.146	1.746	0.135	1.099
	(12.14)**	(29.95)**	(5.80)**	(30.42)**	(28.45)**	(31.33)**	(6.33)**	(16.98)**
R^2	0.02	0.06	0.05	0.08	0.11	0.07	0.01	0.06
N	3,284	3,308	439	3,314	3,315	3,316	3,315	3,317

* $p<0.05$; ** $p<0.01$

	transport	car	school	immunisation	medicine	roompp	stunting	underweight
lnincome	-0.043	-0.017	-0.031	-0.026	-0.014	0.002	-0.054	-0.007
	(6.00)**	(5.69)**	(3.26)**	(1.17)	(0.74)	(0.30)	(6.04)**	(0.68)
_cons	0.515	1.119	0.580	0.235	0.152	-0.004	0.683	0.190
	(8.54)**	(44.68)**	(7.23)**	(1.27)	(0.91)	(0.09)	(9.14)**	(2.25)*
R^2	0.01	0.01	0.00	0.03	0.00	0.00	0.01	0.00
N	3,317	3,304	3,096	50	168	439	2,992	1,495

* $p<0.05$; ** $p<0.01$

Table 4 Validity Test Regression Result for 1997

	water	toilet	floor	indoor	outdoor	refrigerator	washing	fuel	computer	light
lnincome	-0.040	-0.120	-0.037	-0.115	-0.032	-0.166	-0.150	-0.132	-0.009	-0.004
	(4.62)**	(12.25)**	(2.90)**	(3.60)**	(0.95)	(16.61)**	(13.34)**	(13.19)**	(3.12)**	(2.48)*
_cons	0.507	1.792	0.453	1.221	0.966	2.146	1.843	1.845	1.062	0.044
	(6.78)**	(21.11)**	(4.04)**	(4.41)**	(3.32)**	(24.87)**	(18.98)**	(21.43)**	(42.26)**	(2.84)**
R^2	0.01	0.05	0.01	0.05	0.00	0.09	0.06	0.06	0.00	0.00
N	2,787	2,793	1,157	235	243	2,790	2,790	2,854	2,784	2,795

* $p<0.05$; ** $p<0.01$

	tv	telephone	transport	car	school	immunisation	medicine	roompp	stunting	underweight
lnincome	-0.060	-0.171	-0.054	-0.039	-0.035	-0.262	-0.015	0.001	-0.046	-0.017
	(9.41)**	(17.62)**	(5.82)**	(9.48)**	(3.87)**	(2.51)*	(1.30)	(0.18)	(4.87)**	(1.41)
_cons	0.604	2.214	0.662	1.306	0.474	2.396	0.150	0.009	0.587	0.267
	(10.90)**	(26.34)**	(8.26)**	(36.33)**	(6.10)**	(2.63)*	(1.46)	(0.21)	(7.16)**	(2.52)*
R^2	0.03	0.10	0.01	0.03	0.01	0.28	0.01	0.00	0.01	0.00
N	2,794	2,782	2,791	2,780	2,689	18	175	1,148	2,546	1,027

* $p<0.05$; ** $p<0.01$

Table 5 Validity Test Regression Result for 2000

	water	toilet	floor	indoor	outdoor	refrigerator	washing	fuel	computer	light
lnincome	-0.043	-0.133	-0.032	-0.013	-0.138	-0.176	-0.144	-0.137	-0.013	-0.002
	(4.76)**	(13.14)**	(2.67)**	(0.32)	(2.02)*	(16.90)**	(12.97)**	(13.13)**	(3.11)**	(1.38)
_cons	0.575	1.866	0.385	0.220	1.765	2.195	1.740	1.865	1.079	0.025
	(7.17)**	(21.02)**	(3.65)**	(0.61)	(2.87)**	(23.99)**	(17.85)**	(20.28)**	(29.95)**	(1.72)
R^2	0.01	0.06	0.01	0.00	0.06	0.10	0.06	0.06	0.00	0.00
N	2,552	2,567	795	66	62	2,561	2,569	2,574	2,546	2,548

* $p<0.05$; ** $p<0.01$

	tv	telephone	transport	car	school	medicine	roompp	stunting	underweight
lnincome	-0.024	-0.177	-0.015	-0.026	-0.020	0.009	0.003	-0.049	-0.041
	(4.57)**	(16.43)**	(1.72)	(5.81)**	(2.16)*	(0.41)	(0.77)	(5.55)**	(3.02)**
_cons	0.273	2.117	0.322	1.189	0.362	-0.051	-0.016	0.575	0.447
	(5.80)**	(22.32)**	(4.10)**	(30.10)**	(4.37)**	(0.26)	(0.52)	(7.48)**	(3.76)**
R^2	0.01	0.10	0.00	0.01	0.00	0.00	0.00	0.01	0.01
N	2,576	2,559	2,576	2,540	2,358	108	783	2,292	646

* $p<0.05$; ** $p<0.01$

Table 6 Validity Test Regression Result for 2004

	water	toilet	floor	outdoor	refrigerator	washing	fuel	computer	light
lnincome	-0.070	-0.119	0.023	-0.037	-0.139	-0.097	-0.143	-0.041	0.001
	(7.72)**	(10.43)**	(1.37)	(0.20)	(12.06)**	(8.30)**	(12.62)**	(6.29)**	(0.67)
_cons	0.790	1.693	-0.078	0.988	1.835	1.229	1.895	1.286	-0.004
	(9.74)**	(16.55)**	(0.51)	(0.61)	(17.89)**	(11.83)**	(18.67)**	(22.06)**	(0.46)
R^2	0.04	0.07	0.01	0.01	0.09	0.04	0.09	0.02	0.00
N	1,544	1,547	343	9	1,549	1,549	1,541	1,546	1,549

* $p<0.05$; ** $p<0.01$

	tv	telephone	cellphone	transport	car	school	roompp	stunting	underweight
lnincome	-0.022	-0.118	-0.158	-0.044	-0.012	-0.006	-0.004	-0.031	-0.016
	(5.08)**	(10.36)**	(13.62)**	(4.23)**	(2.37)*	(0.95)	(0.81)	(3.74)**	(1.24)
_cons	0.226	1.411	1.873	0.620	1.061	0.138	0.043	0.391	0.233
	(5.88)**	(13.83)**	(18.08)**	(6.73)**	(24.27)**	(2.30)*	(1.01)	(5.28)**	(1.98)*
R^2	0.02	0.06	0.11	0.01	0.00	0.00	0.00	0.01	0.00
N	1,549	1,547	1,548	1,549	1,546	1,546	340	1,432	408

Table 7 Validity Test Regression Result for 2006

	water	toilet	floor	refrigerator	washing	fuel	computer	light
lnincome	-0.065	-0.132	0.030	-0.164	-0.067	-0.109	-0.067	0.000
	(6.68)**	(10.03)**	(1.26)	(12.57)**	(5.39)**	(7.98)**	(7.46)**	(0.21)
_cons	0.727	1.785	-0.167	2.027	0.899	1.510	1.480	-0.001
	(8.28)**	(14.94)**	(0.78)	(17.10)**	(7.92)**	(12.20)**	(18.18)**	(0.10)
R^2	0.03	0.07	0.01	0.11	0.02	0.05	0.04	0.00
N	1,251	1,260	165	1,261	1,261	1,247	1,261	1,259

* $p<0.05$; ** $p<0.01$

	tv	telephone	cellphone	transport	car	school	stunting	underweight
lnincome	-0.004	-0.119	-0.115	-0.026	-0.035	0.000	-0.020	-0.029
	(1.08)	(9.00)**	(9.19)**	(2.15)*	(5.76)**	(0.04)	(2.17)*	(2.06)*
_cons	0.062	1.489	1.360	0.497	1.264	0.085	0.306	0.370
	(1.67)	(12.36)**	(11.93)**	(4.49)**	(22.93)**	(1.21)	(3.62)**	(2.95)**
R^2	0.00	0.06	0.06	0.00	0.03	0.00	0.00	0.01
N	1,261	1,261	1,261	1,261	1,261	1,263	1,149	388

* $p<0.05$; ** $p<0.01$

Table 8 Validity Test Regression Result for 2009

	water	toilet	refrigerator	washing	fuel	computer	light	tv
lnincome	-0.038	-0.090	-0.114	-0.069	-0.065	-0.117	0.001	-0.011
	(4.21)**	(6.34)**	(8.25)**	(5.69)**	(4.63)**	(9.70)**	(0.79)	(3.20)**
_cons	0.466	1.359	1.470	0.891	0.983	1.847	-0.010	0.123
	(5.48)**	(10.11)**	(11.28)**	(7.74)**	(7.48)**	(16.30)**	(0.54)	(3.64)**
R^2	0.02	0.03	0.06	0.03	0.02	0.08	0.00	0.01
N	1,153	1,154	1,156	1,156	1,148	1,156	1,154	1,156

* $p<0.05$; ** $p<0.01$

	telephone	cellphone	transport	car	school	roompp	stunting	underweight
lnincome	-0.111	-0.059	-0.018	-0.042	0.005	-0.008	-0.019	-0.033
	(7.90)**	(6.77)**	(1.49)	(4.91)**	(0.63)	(3.40)**	(2.28)*	(2.35)*
_cons	1.498	0.652	0.379	1.296	0.025	0.078	0.259	0.387
	(11.29)**	(8.00)**	(3.39)**	(16.06)**	(0.36)	(3.66)**	(3.32)**	(2.94)**
R^2	0.05	0.04	0.00	0.02	0.00	0.01	0.00	0.01
N	1,156	1,156	1,156	1,156	1,155	1,148	1,070	365

* $p<0.05$; ** $p<0.01$